



Indiana University Scintillator Optimization Test Setup and Plan

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Motivation



- Cost vs. performance tradeoff
 - Fix performance requirement (#pe's @far end)
 - Vary components to meet requirements AND minimize cost

Modern Liquid Scint. For HEp/Ap



- Scintillant (benzene derivative, e.g. pseudocumene)
 - Atomic/molecular excitations caused by traversing ionizing particle
 - De-excitation produces UV
- Waveshifter(s) (also benzene derivatives, e.g. PPO, POPOP)
 - Absorb UV, re-emit in visible
- “Filler” Solvent (e.g. mineral oil)
 - Passive component
 - Long attenuation length (relative to other components)
 - Allows minimization of photocathode/volume ratio (save \$)



Test Chamber: $2 \times 5 \times 58 \text{ cm}^3 \times 3 \text{ cells}$



Current Liq. Scint. Test Setup



- “MINOS liq. scint. Prototype” extrusions w/alternate walls removed
 - cellsize = 2 cm × 5 cm
 - Length = 58 cm
 - Reflect. = 94% @ 425 nm
- Bicron BC517L scintillator (NOvA baseline)
- Two Bicron WLS fibers per cell, NO loop
 - 0.8 mm × 1.22 m
 - All fiber ends flycut (\approx polished)
- Hamamatsu 4220 PM
 - Nom. QE=10% @550 nm
 - Optical grease couples fiber to PM
- Trigger on Cosmic Rays (muons, electrons) for the ionizing particles

Alpha particle Test flask



- Alpha/muon test particles
- Sits on Burle s83049f PM
- N₂ flow capability
- “sanity check” device



(Near) future setup changes



Current	Future
MINOS prototype extrusions	NOvA prototype extrusions
Hamamatsu PhotoMultiplier	Hamamatsu Avalanche PhotoDiode
Bicron 691A (standard) WLS fiber	Kurary std WLS fiber, UV→green fiber, (UV→blue fiber)
1.2 m length fiber	longer (up to 16 m) fiber
Bicron BC517L scintillator	(see table on next slide)

Scintillator Variables



Item	Purpose	range
PPO	WLS#1	0.1 g/l → 2.5 g/l
POPOP	WLS#2	PPO/1000, PPO/2000, PPO/500
bis-MSB	Alternate WLS#2 (replaces POPOP)	PPO/1000, PPO/2000, PPO/500
pseudocumene	Primary solvent and Scintillant	3%<conc.<15% (possibly tied to PPO)
Naphthalene	Intermediate solvent to improve transfer eff.	primary/10 < conc. < primary/50
Toluene	Primary solvent & Scint. (replaces pseudocumene)	2%<conc.<20%



Summary

- Liquid scintillator optimization test setup in operation
- Improvements (to better match NOvA components) will be implemented as parts/materials become available
- Multidimensional phase space to be searched for cost-performance optimization